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## MANUFACTURER'S POLICIES CONCERNING AVERAGE FUEL ECONOMY STANDARDS

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#### NOTICE

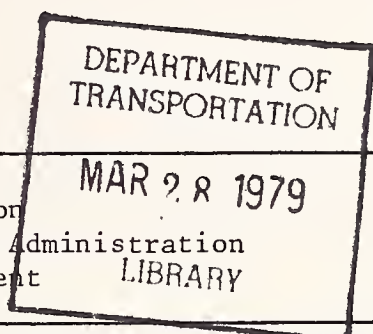
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16. Abstract <p>The National Highway Traffic Safety Administration (NHTSA) has been given the responsibility for implementing the average fuel economy standards for passenger automobiles mandated by the Energy Policy and Conservation Act (P.L. 94-163). The standards, in miles per gallon, for 1978, 1979 and 1980 are stipulated in the legislation. Fuel economy standards for 1981 and 1984 are to be established by rulemaking. The standard for 1985 is set at 27.5 mpg; however, the Secretary may set the standard for 1985 as low as 26 mpg without further action by Congress.</p> <p>The form of regulation, i.e., the imposition of standards on the basis of each manufacturer's total production for a given model year, as well as the criteria to be applied by NHTSA in setting the 1981 through 1985 standards, require that very careful attention be given to understanding both the probable responses of each manufacturer and the economic and other consequences of such responses. The AFER (Average Fuel Economy Regulatory) Program at TSC is intended to assist NHTSA in the analysis of options for setting average fuel economy standards and applying the criteria of Title V of the Motor Vehicle Information and Cost Savings Act (Title III of EPCA) for an evaluation of these options.</p>					
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## PREFACE

The present study is directed toward providing a preliminary analysis of automobile manufacturers' probable responses and of issues bearing on their decision-making for meeting the fuel economy standards. The specific objectives for this study were as follows:

- 1) Identify for each manufacturer the various options, technological and nontechnological, that it is likely to invoke in response to alternative schedules for average fuel economy standards for the 1981 through 1985 model years.
- 2) Discuss the rationale or bases upon which each manufacturer will rank and select from among its available options.
- 3) Develop a set of hypothetical scenarios for the domestic automotive industry that represents the most likely responses to alternative schedules for 1981-1985 model years.
- 4) Assist TSC and NHTSA in the clarification of information and research needs and relevant policy issues concerning the selection of a schedule of 1981-1985 model year average fuel economy standards for proposed rulemaking.

The work to be performed was divided into four tasks, identified as follows:

Task 1 - Alternative Schedules for Average Fuel Economy Standards for 1981-1985 MY's.

Task 2 - Manufacturer Options.

Task 3 - Exogenous Factors That Bear on Implementation of the Standards.

Task 4 - Manufacturer Strategies

It should be noted that the present study was conceived and Tasks 1 and 3 were reported before Secretary Brock Adams' issuance of a final rulemaking on the 1981-1984 fuel economy standards on June 26, 1977. While the discussion of issues in Task 1 has been effectively mooted by the subsequent rulemaking, it is believed that they may still be of value.



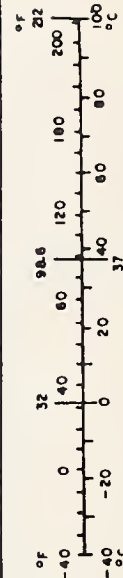
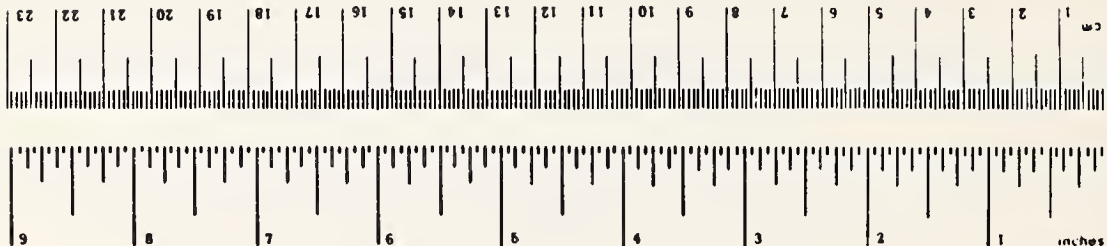
# METRIC CONVERSION FACTORS

## Approximate Conversions to Metric Measures

Symbol	What You Know	Multiply by	To Find	Symbol
<b>LENGTH</b>				
in	inches	2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
<b>AREA</b>				
in <sup>2</sup>	square inches	6.5	square centimeters	cm <sup>2</sup>
ft <sup>2</sup>	square feet	0.09	square meters	m <sup>2</sup>
yd <sup>2</sup>	square yards	0.8	square meters	m <sup>2</sup>
mi <sup>2</sup>	square miles	2.6	square kilometers	km <sup>2</sup>
	acres	0.4	hectares	ha
<b>MASS (weight)</b>				
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons	0.9	tonnes	t
	(2000 lb)			
<b>VOLUME</b>				
tap	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.96	liters	l
gal	gallons	3.8	liters	l
ft <sup>3</sup>	cubic feet	0.03	cubic meters	m <sup>3</sup>
yd <sup>3</sup>	cubic yards	0.76	cubic meters	m <sup>3</sup>
<b>TEMPERATURE (exact)</b>				
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

## Approximate Conversions from Metric Measures

Symbol	What You Know	Multiply by	To Find	Symbol
<b>LENGTH</b>				
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
<b>AREA</b>				
cm <sup>2</sup>	square centimeters	0.16	square inches	in <sup>2</sup>
m <sup>2</sup>	square meters	1.2	square yards	yd <sup>2</sup>
km <sup>2</sup>	square kilometers	0.4	square miles	mi <sup>2</sup>
ha	hectares (10,000 m <sup>2</sup> )	2.5	acres	
<b>MASS (weight)</b>				
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
<b>VOLUME</b>				
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m <sup>3</sup>	cubic meters	36	cubic feet	ft <sup>3</sup>
m <sup>3</sup>	cubic meters	1.3	cubic yards	yd <sup>3</sup>
<b>TEMPERATURE (exact)</b>				
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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## 1. ALTERNATIVE SCHEDULES FOR AVERAGE FUEL ECONOMY STANDARDS FOR 1981-1985 MY'S

The NHTSA was charged with the responsibility for establishing, by rulemaking no later than July 1, 1977, the passenger automobile average fuel economy standards for 1981-1984 model years. While only these four model year passenger automobiles are immediately at issue, it is necessary that consideration be given to setting the 1985 standard and, quite possibly, to evaluating the issues of standards for succeeding model years and the effects of non-passenger automobile (NPA) fuel economy standards.

Section 502 of the Motor Vehicle Information and Cost Savings Act requires that the 1981-1984 standards "be set for each model year at a level which:

- 1) Is the maximum feasible average fuel economy; and
- 2) Will result in steady progress toward meeting the average fuel economy standard for MY 1985."<sup>1</sup>

The fuel economy standard for 1985 was set by Congress as 27.5 mpg; however, the Administrator (of NHTSA) may find that the maximum feasible fuel economy level is higher or lower than the 27.5 and "he is authorized to establish by rulemaking a higher or lower level (subject to congressional review if higher or more than 1.5 mpg lower)."<sup>2</sup> The work statement for the present study, written in December 1976, stipulated that three sets of schedules for passenger automobile average fuel economy standards should be considered:

- 1) Current mandate -
  - a) 27.5 mpg for 1985
  - b) 26.0 mpg for 1985
- 2) Manufacturers' recommendation -  
23-24 mpg for 1985 with a freeze thereafter
- 3) Delay in implementation of mandated standards -  
23-24 mpg for 1985 with 26-27.5 mpg targeted for 1990.

In each case, intervening years were to be based on a straight-line interpolation, unless there appear to be compelling reasons for

Superscripted numbers refer to the list of references at the end of each section.

consideration of an other than straight-line interpolation. In the absence of a determination of what is maximally feasible within the EPCA form of regulation or any determination of the possible costs and benefits of alternative forms of regulation of automotive fuel economy, it is recommended that a wider range of options than the preceeding three schedules be given consideration by the NHTSA, at least to the extent consistent with the criteria set forth in the Act, as amplified by the Conference Report,<sup>3</sup> as discussed in the Proposed Rulemaking,<sup>4</sup> and as discussed during the Hearings<sup>5</sup> and subsequent written submissions of the manufacturers.<sup>6</sup>

The notice of proposed rulemaking does not propose a specific schedule of 1981-1984 fuel economy standards; rather, the notice "sets forth the specific issues which will be considered in the establishment of final standards and procedures for the presentation of views at the hearing and the submission of written comments. Due to the limited time remaining until July 1, 1977, it is necessary that this notice be a 'description of the subjects and issues involved'...rather than a more specific RPRM which proposes specific numerical standards."<sup>7</sup> Both the ANPRM and the NPRM, as well as the President's legislative proposals for a "Fuel Inefficiency Tax,"<sup>8</sup> in effect presume a linear interpolation of mpg values from the statutory 1980 value of 20 mpg to the 1985 requirement of 27.5 mpg unless there are strong contraindications for either the 1985 value or for other linear interpolations. In this regard, the NPRM holds that "the extent to which deviations from this straight line are permissible is a serious issue."<sup>9</sup> The issue of setting the intermediate values between 1980 and 1985 is discussed below with reference to interpretations of the "steady progress" requirement.

First, however, it is appropriate to characterize the range of options which NHTSA might well consider, if not within the present rulemaking because of time limitations, at least with reference to analyses in support of mandated reporting requirements.<sup>10</sup> Three general categories of options, each of which presents a variety of choices, can be distinguished:

- 1) Average fuel economy standards not requiring Congressional review, i.e., uniform standards applicable to all manufacturers leading to a 1985 value in the range of 26 to 27.5 mpg.
- 2) Average fuel economy standards requiring Congressional review, e.g.:
  - a) uniform standards with a 1985 value higher than 27.5 mpg,
  - b) uniform standards with a 1985 value lower than 26.0 mpg,
  - c) nonuniform standards, or a schedule of required fuel economy improvements applied separately to each manufacturer's base year fleet average.
- 3) Alternatives to the application of average fuel economy standards requiring Congressional amendment of existing statutes, e.g.:
  - a) a single, minimum fuel economy standard applicable to all passenger automobiles, or a schedule of progressively higher, minimum fuel economy standards for all passenger automobiles for successive future model years,
  - b) a set of single, minimum fuel efficiency standards for approximately defined separate classes of passenger (and nonpassenger) automobiles,
  - c) a schedule of excise taxes or excise taxes and rebates or annual registration fees based on measured composite fuel economy in lieu of average fuel economy standards, or other market incentives/disincentives.

There are obviously other variations of Category 2 and 3 options that could be suggested. While NHTSA may feel that it cannot appropriately evaluate any category 3 options for the present rule-making, an analysis of potential economic and other impacts of fuel economy regulation would be incomplete without such consideration. The present study, however, concentrates on issues of manufacturer decision-making and probable responses in relation to anticipated



Category 1 or 2 average fuel economy standards. Some additional observations apropos the desirability of examining Category 3 options are presented in the Task 3 discussion.

As noted, the legislation requires NHTSA to set the '81 to '84 standards at a level which is both the "maximum feasible" level for each MY and which represents "steady progress" toward meeting the standard established for 1985. First, interpretations are considered of the steady progress requirement in relation to Category 1 choices; however, the same rationale would apply should the determination of what is the maximum feasible level lead to the selection of a Category 2 set of standards. There are several equally rational interpretations of steady progress such that this is clearly not a sufficient criterion, and the selection of a "rule of rationality" must depend upon other "considerations." The most obvious interpretation, and that presumed by NHTSA and the White House, is that of a linear interpolation or a constant annual increment in average miles per gallon. The two implied Category 1 schedules are as shown in Table 1.

A second rational interpretation is that of a constant percentage increase in average miles per gallon which in the case of the 27.5 mpg for 1985 is approximately 6.58 percent and in the case of 26.0 mpg for 1985 is approximately 5.39 percent. Table 2 shows the implied schedules, with values rounded to the nearest tenth.

A third, equally rational interpretation involves a linear interpolation of the reciprocals of miles per gallon, i.e., a uniform decrease in gallons per mile. The resulting two schedules are shown in Table 3.

The schedules in Tables 2 and 3 provide increasing annual mpg increments, a situation that would be "natural" if there was reason to expect a response characteristic of the early part of a learning curve. One could as readily create two additional tables in which the order of annual increments is reversed, or apply other rational rules for decreasing annual mpg increments, which would

TABLE 1. CATEGORY 1 - LINEAR INTERPOLATIONS

<u>YEAR</u>	<u>MILES PER GALLON</u>	
1980	20.0	20.0
1981	21.5	21.2
1982	23.0	22.4
1983	24.5	23.6
1984	26.0	24.8
1985	27.5	26.0

TABLE 2. CATEGORY 1 - CONSTANT PERCENT INCREASE

<u>YEAR</u>	<u>MILES PER GALLON</u>	
1980	20.0	20.0
1981	21.3	21.1
1982	22.7	22.2
1983	24.2	23.4
1984	25.8	24.6
1985	27.5	26.0

TABLE 3. CATEGORY 1 - UNIFORM DECREASE IN GALLONS PER MILE

<u>YEAR</u>	<u>MILES PER GALLON</u>	
1980	20.0	20.0
1981	21.2	21.0
1982	22.4	22.0
1983	23.9	23.2
1984	25.6	24.5
1985	27.5	26.0

be appropriate for a later or mature stage on a learning curve. These latter schedules would be appropriate if the expected means for achieving the fuel economy improvements were essentially technological and there was reason to believe that there would be decreasing marginal returns on the investments in technology, i.e., that the major available technological gains had already been achieved (which may or may not be true). This latter type of schedule would also be preferable, if feasible, because of the earlier returns in fuel economy improvement and reduced fuel consumption benefit. As will be demonstrated later, the problem is only in part, and quite likely only in minor part, a technological one. For this and additional reasons, either of the schedules in Table 2 or 3 are, if feasible, believed to be preferable over the straight-line or one or another of the inverse or accelerated schedules--at least in relation to the steady progress criterion.

A strong, and perhaps compelling, reason for selecting as the "rational rule" that of Table 3 over that of Table 2, is that so doing compensates, in part, for the dual-bias against the lower fuel economy numbers introduced by the use of harmonic means, first, in determining the "average" combined city/highway fuel economy, and second, in determining a manufacturer's fleet "average" fuel economy. The harmonic mean has the well-known property of increasing the weight of the lowest values being "averaged." This effect can be illustrated in the computation of the combined city/highway fuel economy. The intended or nominal weighting is 55



percent city/45 percent highway. Assume, for example, that for a particular vehicle, the city performance is 18 mpg and the highway performance is 24. The arithmetic and harmonic means are as follows:

Arithmetic mean = 20.7 mpg

Harmonic mean = 20.28 mpg.

The effect of the harmonic in relation to the arithmetic mean is an increase of the city weighting from 55 percent to 62 percent. If the city and highway mpg figures were 16 and 24 respectively then the resulting means are:

Arithmetic mean = 19.6 mpg

Harmonic mean = 18.82 mpg.

The comparable weighting in this case is 64.75 percent city to 35.25 percent highway. The same effect is present in determining a manufacturer's fleet average fuel economy; the lower fuel economy vehicles are weighted higher than their proportion in the fleet due to the use of harmonic means.

Short of having made a determination of what are the maximum feasible standards, there is no assurance that the level for 1985 falls within the statutory range. Accordingly, it should be incumbent upon NHTSA to consider values both above 27.5 and below 26.0. Table 4 suggests three Category 2 schedules, all computed on the basis of a uniform decrease in gallons per mile, one with value of 29 mpg for 1985, one with the statutory 1985 value of 27.5 delayed one year but with a continuing requirement for improvement to 31.5 mpg in 1988, and the third with a 1985 value of 25.0 mpg.

The NPRM asks how potential conflicts between steady progress and maximum feasibility requirements can be reconciled. Since the selection of a reasonable rule for steady progress depends on matters other than its internal logic, e.g., on manufacturer capability and market response, issues relating to what is practically achievable or maximally feasible are of critical importance.

TABLE 4. CATEGORY 2 - UNIFORM DECREASE IN GALLONS PER MILE

<u>YEAR</u>	<u>MILES PER GALLON</u>		
1980	20.0	20.0	20.0
1981	21.3	21.0	20.8
1982	22.8	22.0	21.7
1983	24.6	23.2	22.7
1984	26.6	24.5	23.8
1985	29.0	25.9	25.0
1986	-	27.5	-
1987	-	29.4	-
1988	-	31.5	-

We turn now to the vastly more difficult issues of assessing what is maximally feasible and related concerns bearing on NHTSA's setting of average fuel economy standards for 1981 through 1984 model year passenger automobiles. The legislation specifically identifies four factors to be given consideration in determining what is the maximum feasible level for each model year:

- 1) Technological feasibility,
- 2) Economic practicability,
- 3) The effect of other Federal motor vehicle standards on fuel economy, and
- 4) The national need to conserve energy.

Both the ANPRM and the NPRM discuss and present these four factors as issues for comment by the manufacturers and other interested parties. These issues were also addressed by the "Support Document"<sup>11</sup> and formed the subject of discussion during the March 22-24, 1977 public hearings. There is, however, relatively scant guidance provided in the legislation or the Conference Report concerning the interpretation and application of these criteria, particularly the critical factor of economic practicability.

We do not propose to review here all of the discussion that has taken place, but rather to select and comment upon those issues that appear most relevant to the subsequent discussions in Tasks 2 and 4, of manufacturer choice and strategy, and to the NHTSA's

selection of an appropriate progression of standards for the '81-'84 model years. In a strict or narrow sense, the question of technological feasibility is a nonissue. There is no question that the automobile industry can produce and is now producing vehicles that meet the target 1985 or higher standards. The legislative history is silent on what technological feasibility means in the context of this legislation, but one might presume that the intent was to include, in some sense, the complementary issue of meeting consumer demand--which is perhaps implicit in the whole concept of applying standards on a corporate fleet average basis. In this case, clearly, technological feasibility is not a sufficient criterion. Concerning technological choices to improve fuel economy, there appears to be little significant disagreement on the part of the industry with the options--particularly the Class I options--considered in NHTSA's support documents. There is disagreement, however, on the specific magnitudes of fuel economy gains, the extent to which they are additive, and particularly on the perception of the risks involved. The question for the industry is not primarily one of technological risk in the sense of whether a particular technology can be made to work, although there is substantial uncertainty regarding some items, e.g., of new engine developments also meeting emission standards. The predominant concern is with the financial and marketing risks of introducing product changes which may affect the consumers' perceptions and preferences. The case was stated by General Motors in its response to NHTSA's Fuel Economy Questionnaire of April 1, 1977 in the following terms: "Marketability of our products is no less an ingredient to be reckoned with than, say, improved transmissions in establishing fuel economy standards within the economic and feasibility constraints imposed by the Energy Act."<sup>12</sup> A final comment: The NPRM provides a listing of "types of technology to be considered," which concludes with "reductions in vehicle performance, and marketing incentives and initiatives to encourage demand for smaller cars."<sup>13</sup> While there may be some quibble about whether reductions in vehicle performance should be construed as a type of technology, the suggestion that marketing incentives and

initiatives to shift demand represents a technological option runs counter to all normal and accepted use of the language.

The fourth criterion, of the national need to conserve energy, is really gratuitous. It does not, particularly under the EPCA, provide any basis for qualifying or applying the criterion of maximum feasibility. The President's legislative proposal<sup>14</sup> and The National Energy Plan<sup>15</sup> present specific national energy conservation goals, including the reduction of gasoline consumption, but what is maximally feasible under a program of new passenger automobile average fuel economy standards may or may not achieve the stated goals. Issues raised by the proposed excise tax/rebate scheme and gasoline taxes are, appropriately, considered under Task 3--exogenous factors.

The third criterion, the effect of other Federal motor vehicle standards on fuel economy, permits NHTSA to reduce fuel economy standards on the basis of its finding that other motor vehicle standards, i.e., for emissions, safety, damagability or noise, more stringent than those in effect in 1975, adversely affect fuel economy when the manufacturer has "applied a reasonably selected technology."<sup>16</sup> The issue of whether or the extent to which such other standards will force a sacrifice in fuel economy has been discussed extensively in the public record and need not be reviewed here. While the manufacturer must consider the trade-offs of different technological choices as each choice affects the range of regulatory requirements (and, of course, preferences as well), the matter of major concern is that of coping with the uncertainty of future regulations which may have the effect of jeopardizing decisions and investments made in response to current regulations. It should be noted, as is discussed in Task 3, that there are other potential types of government action and regulation, e.g., current energy legislative proposals, which can affect manufacturer decision-making as well as consumer choice and behavior regarding the automobile and hence affect the costs and effects of achieving a compliant fuel economy mix.



We turn now to a consideration of the criterion of economic practicability. The Conference Report provides some guidance which, nevertheless, leaves considerable doubt and confusion about the proper interpretation and application of this criterion. Quoting from the Conference Report and then the Act itself, with emphases added: "...any such determination [of maximum feasible average fuel economy] will lead to an average fuel economy standard applicable to all manufacturers in a given segment of the motor vehicle industry. Such determination should therefore take industry wide considerations into account. For example, a determination of maximum feasible average fuel economy should not be keyed to the single manufacturer which might have the most difficulty achieving a given level of average fuel economy. Rather, the Secretary must weigh the benefits to the nation of a higher average fuel economy against the difficulties of individual automobile manufacturers. Such difficulties, however, should be given appropriate weight in setting the standard in light of the small number of domestic automobile manufacturers that currently exist, and the possible implications for the national economy and for reduced competition association (sic) with a severe strain on any manufacturer. However, it should also be noted that provision has been made for granting relief from penalties under Section 508(b) in Situations where competition will suffer significantly if penalties are imposed."<sup>17</sup> "The Secretary shall have the discretion to compromise, modify, or remit, with or without conditions, any civil penalty assessed under this subsection against any person, except that any civil penalty assessed for a violation of Section 507(1) or (2) may be so compromised, modified, or remitted only to the extent--

"(A) Necessary to prevent the insolvency or bankruptcy of such manufacturer,

"(B) Such manufacturer shows that the violation of Section 507 (1) to (2) resulted from an act of God, a strike, or a fire, or

"(C) The Federal Trade Commission has certified that modification of such penalty is necessary to prevent a substantial lessening of competition, as determined under paragraph (4)."<sup>18</sup>

It should be noted that the above instructions apply to all four

criteria for determining maximum feasibility, but they especially have relevance to the matter of economic practicability. First, we offer some observations concerning the above extracts:

- a) Presumably, the reference to "a given segment of the motor vehicle industry" is intended to refer to passenger automobiles as a single class and hence to all automobile manufacturers. On this basis, American Motors' suggestion of separate standards for individual manufacturers would have to be rejected. It might be argued, however, that certain types of passenger (or 3- or 4- or n-passenger) automobiles, represent separate segments of the industry and that manufacturers of such types of vehicles be given separate consideration.
- b) It is clear that Congress does not want standards set on the basis of the least capable manufacturer, but how the difficulties of one, or another, manufacturer are to be weighed against to national benefits of a higher standard is not at all clear.
- c) While Congress evidenced an apparent concern for the potential competitive damage of the average fuel economy standards, the only explicit relief provided is the remission of the civil penalties for non-compliance. This, of course, would provide no relief for an automobile manufacturer threatened with or facing bankruptcy; e.g., one company could find itself unable to compete and thus the questions of compliance and civil penalties would be moot. Whether the potential bankruptcy of one or another automobile manufacturer is an acceptable cost for achieving some level of fuel conservation is not clear. There is also the complicating factor of determining whether or to what extent a potential bankruptcy is attributable to the imposition of average fuel economy standards or to other "causes."
- d) There is no explicit comment or direct suggestion that the issue of economic practicability requires a justification in cost/benefit terms, e.g., that the benefits should exceed the costs.



NHTSA has placed considerable stress, in its Support Documents, the ANPRM, NPRM, and during the public hearings, on the estimation of costs and capital investments associated with the various technological options for improving fuel economy and particularly with the estimation of what costs could be incrementally attributable to the average fuel economy standards. These analyses, while certainly important, appear to miss the critical issue, so frequently mentioned by the manufacturers, of marketability and of gauging the consumers' responses to the menu of choices available to them at any one time and to their anticipations of things to come. It is in this area, unfortunately, that the greatest uncertainty abounds and the greatest risks to individual manufacturers are to be encountered. There is no question but that Congress intended to force a change in automobile characteristics that it perceived that market of itself would not bring about, otherwise there would be no need for imposing any fuel economy standards. To the extent, therefore, that the accomplishment of the desired changes, i.e., of the industry's meeting the statutory standards, implies a realignment or shift in consumer preferences or a change in product mix from that which would otherwise obtain, then the costs and other effects of this dislocation should be reckoned as central to the issue of economic practicability or of determining what is the maximum feasible schedule of standards for the 1981 through 1985 time frame. In this regard, it must be borne in mind that the automobile-using public, the consumer, has a considerably wider range of choice than that of which make and model of new car to purchase in any given year. The testimony of the domestic manufacturers reveals their conviction that meeting, say, a schedule of standards based on 1.5 mpg increments to a 1985 value of 27.5 mpg. will almost certainly entail actions other than the application of available technology for the improvement of fuel economy. The actions at issue are market forcing actions.

It is held, therefore, that the assessment of economic practicability requires an assessment of the economic impacts of alternative schedules and that this, ideally, requires an ability

to forecast, as a function of all of the factors that affect new car demand, what the new car sales and mix would be in the absence of the standards and then what the new car sales and mix would be for each schedule of standards to be considered, including the manufacturers' responses thereto. This, of course, is an enormous order, and there is considerable doubt whether any extant models of forecasting techniques can adequately deal with the complexity of the interactions. The task, if not impossible, is clearly beyond the scope of the present study; however, a number of issues bearing on the manufacturer's responses and assessments are discussed in following tasks. It must be maintained, however, that the fact of the imposition of average fuel economy standards, in which compliance can only be determined after the fact of the vehicles having been entered into commerce and the consumers having rendered their collective purchase decisions, creates a situation in which the issue of feasibility is inseparable from questions of marketability and consumer response.

## REFERENCES FOR SECTION 1

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2. 41 FR 41713.
3. U.S. Congress House of Representatives, Energy Policy and Conservation Act Conference Report, Report No 94-700, December 9, 1975. [Conference Report].
4. DOT/NHTSA, Proposed Rulemaking Concerning Passenger Automobile Average Fuel Economy, Draft, March 21, 1977. [Proposed Rulemaking].
5. Transcript of Proceedings: Public Hearings on Automotive Fuel Economy Standards 1981-1984, March 22-24, 1977, Ace-Federal Reporters, Inc.
6. Specifically the written replies in the public record to the NHTSA Order of April 1, 1977: Fuel Economy Questionnaire.
7. Proposed Rulemaking, Op. cit., p. 28.
8. U.S. Congress, National Energy Act - Communication from The President of the United States, House Document No. 95-138, April 29, 1977, pp. 170-173.
9. Proposed Rulemaking, Op. cit., p. 39.
10. P.L. 94-163, Section 502(a)(2).
11. U.S. DOT/NHTSA, Data and Analysis for 1981-1984 Passenger Automobile Fuel Economy Standards, Summary Report; Document 1 - Automobile Demand and Marketing; Document 2 - Automotive Design and Technology, Volumes I & II; Document 3 - Automobile Manufacturing Processes and Costs; Document 4 - Financial Analysis of the U.S. Automotive Manufacturers, February 28, 1977.

12. General Motors Response to the Fuel Economy Questionnaire of April 1, 1977. NHTSA Docket No. 76-01-No. 3-108, April 12, 1977.
13. Proposed Rulemaking, Op. cit., p. 33.
14. National Energy Act..., Op. cit.
15. Executive Office of the President, Energy Policy and Planning, The National Energy Plan, Washington, D.C., April 29, 1977.
16. Conference Report, Op. cit. p. 155.
17. Ibid., p. 154.
18. P.L. 94-163. Section 508 (b)(3).

## 2. MANUFACTURER OPTIONS

### 2.1 GENERAL

Task 2 identifies and discusses the various options, both technological and nontechnological, available to each of the domestic automobile manufacturers. Task 4 will then explore and attempt to characterize the likely strategies of each of these manufacturers concerning its compliance with the average fuel economy standards. The Task 2 discussion also considers the factors that will be assessed by the manufacturers in their evaluation of the desirability or ranking of the available options.

The NHTSA in its Support Documents considers two classes of options: "The technological options for improving automobile fuel economy can be divided into two broad classes. Class I options will be defined as those technological options which result in improved fuel economy without significantly impacting the major functional attributes of the automobile (such as interior passenger/baggage volume and acceleration performance). Class II options are defined as those options which result in increased fuel economy through market class shifts, and imply a reduction in interior passenger/baggage volume and/or a reduction in power to weight ratio, or acceleration performance."<sup>1</sup> In the Executive Summary, NHTSA concludes: "Class I technological options include: (1) Vehicle downsizing with little or no change in interior volume, or power-to-weight ratio; (2) material substitution with no change in marketable attributes of the car; (3) improved spark ignition engines; (4) introduction of 3-speed and 4-speed, or equivalent, automatic transmissions both with torque converter lock-up; and (5) dieselization.... Present analysis indicates no significant impact on the functional attributes of individual automobiles and the fleet, nor is it believed that marketability will be significantly effected (sic). The Class II options, which require changes in product mix and fleet average power-to-weight ratio, can provide additional improvements in fuel economy, but will have adverse



impacts on automobile and fleet functional attributes, and may adversely affect marketability."<sup>2</sup> NHTSA also concludes: "Different combinations of these Class I options in conjunction with the vehicle-downsize program currently underway provide a means for attaining a new-car fleet average fuel economy of 26 to 27.5 miles per gallon by 1985."<sup>3</sup> The question of the reasonableness of NHTSA's assumption that no significant change in "functional attributes" is equivalent to no significant change in "marketability," i.e., in consumer response or acceptance is considered below in relation to factors the manufacturers "must" assess.

While the distinction between what is a technological option and what is a nontechnological option can become fuzzy, in general, by a "technological option" is meant any tangible change in product characteristics intended to improve a vehicle's fuel economy or a change in manufacturing process made in support of new product programs, and by a "nontechnological option" is meant any marketing or related area of business decision-making concerning a firm's achievement (or nonachievement) of a complaint mix.

Perhaps a more useful distinction, and one which in many respects has the same force, is between options or actions a manufacturer may consider and take well in advance of a given model year and those options or actions which it may take during a given model year--but will, of course, attempt to evaluate in advance.

The former class of options is largely related to product planning and the cognate concerns of the company's research and development, product design, engineering (both prototype and production), manufacturing and sourcing, but they will also include nontechnological issues of capacity and facilities planning, capital investment and financial analyses, and overall product-line strategy. This class of options, then, involves commitments on relatively long lead-time items, which once made are relatively inflexible.<sup>4</sup> The assessment of these options by each manufacturer will be a function of its resources, present product line and market position and its anticipations of market opportunities and changes in consumer behavior as well as its perceptions of competitive actions and other developments.



The latter class of options, those a manufacturer may invoke during a model year, can be appropriately viewed as potential corrective actions for either a failure to correctly anticipate market response, or the intervention of exogenous factors, or the insufficiency of the company's prior product or other planning decisions. This latter class of options are important for the manufacturer in that they do not require prior capital commitments, and they provide an important element of flexibility for coping with the many uncertainties in the marketplace. The way in which such options may be taken by one or another manufacturer, e.g., by introducing larger than normal price differentials between different car classes, may raise important questions about the competitive impact and economic consequences of legislating average fuel economy standards. It should also be noted that the availability of this latter class of options introduces a major component of uncertainty into the whole regulatory process and the evaluation of the potential impacts of regulatory alternatives. The manufacturers can rightly say that at this time, or at any time up to and including a model year in question, they do not know whether, or to what extent, they may "need" to invoke one or a combination of such options. Any analysis of this class of options must be speculative and deal with subjective probabilities, based upon an imperfect understanding of automobile market dynamics but aided to some extent by economic theory. Tending to further complicate the picture is the question of the extent to which a manufacturer's technological and other choices in the product area may be affected by its perceptions and assessments of the need for or the efficacy of this latter class of nontechnological options.

For convenience although somewhat imprecisely, we shall refer to the class of options for which significant financial commitments must be made in advance of a given model year as technological options and those not requiring such commitments as nontechnological options. These two classes of manufacturers' options are discussed below.

## 2.2 TECHNOLOGICAL OPTIONS

While NHTSA characterizes its Class I technological options as those which do not significantly affect the "major functional attributes of the automobile," the basic intent of the distinction between Class I and Class II is that Class I options are viewed as neutral with respect to any implied change in market segmentation, consumer acceptance or manufacturer's sales mix. The manufacturer, however, cannot afford the luxury of this assumption and must view any and all potential product changes in terms of an assessment of their likely effects on consumer perceptions, valuations and purchase decisions. The manufacturers understand well that automobiles are not sold solely on the basis of their functional attributes, except to a minority of buyers. While it is clear that the three attributes considered by NHTSA, viz. interior passenger volume, baggage volume and acceleration performance, are important, they are not all-important. It is correct, if not very helpful, to say that the automobile (both passenger and nonpassenger) represents a complex bundle of attributes (both tangible and intangible) each of which may be perceived and valued differently by different segments of the market in relation to the age, income, life style or other characteristics of the families, households or individuals who purchase and use automobiles. The task of understanding and attempting to quantify these valuations and their changes over time is a major responsibility of marketing and marketing research.

Thus the industry's current downsizing programs, assuming interior passenger/baggage volumes and acceleration performance are held constant, involve a marketing risk that cannot be accurately gauged at the present time, for it is probably more likely than not that the consumers' perceptions of the changes, ignoring for the moment other factors, will result in shifts in the sales mix of each manufacturer, and of the market as a whole. The above is not intended to suggest that there are no technological options for fuel economy improvement that are neutral from a marketing point of view, but rather to emphasize that the automobile manufacturer must seek to evaluate all technological and product changes

in terms of their costs and other dimensions of business decision-making (including other areas of federal regulation).

Apropos the assessment of the marketability of (or consumer response to) any and all technological product options, it must be emphasized in the strongest possible terms that the market's response will be affected by both the consumers' perceptions of the product changes (either positive or negative or neutral) and by the manufacturers' pricing and other marketing actions that are made in response to their individual imperatives to sell a compliant mix. Thus, while it may be possible to say that a given product change, of itself, is likely to engender a positive, neutral or negative consumer response, the "force" of that response may be overpowered or swamped by a pricing differential. (See Section. 2.3.) The manufacturer's assessment of various technological and advanced planning options will, to varying degrees, depend in part on its perceptions and assessments of its future pricing or other marketing programs.

Unfortunately, but realistically, the consideration of technological options is not entirely straight-forward. This notwithstanding, the manufacturers will attempt to assess the potential fuel economy gains of such options and their combinations in order to determine how far these product and other changes will carry the company toward meeting the standards. The following represents the scope and variety of technological and advanced planning options that involve substantial commitments of capital resources (including the obsolescence of capital facilities):

1. Product Changes.

- A. Add new models/car lines.

1. Small, fuel economical cars at the bottom of the line.

2. Larger, but less fuel economical cars to "balance" the line and provide "averaging" flexibility.

- B. Delete models/car lines, i.e., top of the line "gas guzzlers."

- C. Modify, redesign, reengineer existing products, within and/or across product lines.



1. Body and chassis changes, e.g., "downsizing," materials substitution, drag reduction, suspension changes.
2. Powerplant and powertrain changes, e.g., improved carburetion and/or fuel injection (including continuous feedback controls), improved transmissions (including 3- and 4-speed automatics with lockup), dieselization, other improved spark ignition engines (including various stratified charge concepts, dual and multi-mode operations, heat engine hybrids--electrical and mechanical with regenerative braking), Brayton, Stirling or other continuous combustion engines, front-wheel drive, improved lubricants, engine downsizing (i.e., reduction in horsepower to weight ratios), axle ratio changes, materials substitutions, etc.

## II. Production and Manufacturing Changes

- A. Capacity changes, including phasing-in and phasing-out of production facilities.
- B. Process changes to increase flexibility, including consideration of increased use of automation and numerical controls, multi-purpose facilities (assembly, engine and major component fabrication), quick-change and standby tooling, elimination of single-line plants.

Each manufacturer's consideration of the above, and possibly other, options will be a function of its assessment of the associated financial, marketing and competitive risks, in relation to the following:

- a) Current product line(s) and market position,
- b) Capital and financial resources,
- c) Engineering and technology base,
- d) Status and timing of advanced R&D programs,
- e) Expected changes in other (nonfuel economy) federal regulations as well as belief that EPCA can/will (cannot/will not) be changed,

- f) Need to demonstrate a "good faith" effort toward compliance,
- g) Perceived opportunities to expand nonpassenger automobile markets,
- h) Availability of "corrective" actions.

### 2.3 NONTECHNOLOGICAL OPTIONS

We turn to a consideration of the so-called "nontechnological" options. Undoubtedly the most powerful and the most important is that of pricing. The pricing issues, however, are both extremely complex and subject, at the present time, to considerable uncertainty. As already noted the set of nontechnological and current year marketing options can, and probably will, be viewed by the manufacturers as measures for "fine tuning" or perhaps, more appropriately, as potential corrective measures to compensate for their miscalculations or incorrect anticipations of what is needed to produce a compliant mix of passenger cars.

We consider first the pricing issue. It affects each of the manufacturers differently in relation to their product lines, market position and segmentation and the extent to which their fuel economy improvement programs carry them toward compliance without requiring a shift in market mix or the market itself shifts in response to various exogenous factors.<sup>5</sup> As will be seen, the issue also has important competitive implications, for each company's pricing decisions will be constrained or influenced by those of the other manufacturers.<sup>6</sup> A discussion of the pricing and other marketing implications of average fuel economy regulation must be speculative, since it is not possible to determine, for any given future model year and its specific standard, whether each company could sell a compliant mix without recourse to extraordinary pricing measures. Certainly the possibility exists, and the probabilities increase as the standards become more stringent. By "extraordinary" pricing is meant any set of prices intended to force a shift in mix that involves lower than normal prices (and reduced, possibly negative, margins) on some car lines which

are compensated by higher prices and increased margins on other lines. Such pricing represents an internal cross-subsidy, even if the small cars offered at lower than normal prices are not sold below cost. To better gauge the impact of fuel economy pricing, it is appropriate to consider first the issue in relation to economic theory and then in relation to manufacturer choice concurrent with the marketing of a regulated model year's vehicles.

In principle, for any specified average fuel economy standard--within the range under consideration and even higher--there is a set of average prices by car class that would result in the market as a whole buying a compliant mix of vehicles. This may be called the "industry demand function." The higher the standard, the larger the price differential between small and large cars. Similarly, for each of the manufacturers considered separately, there exists a set of manufacturer-specific prices that would cause its sales to be in compliance--what might be called the manufacturer-specific "compliance demand functions." These demand functions, of course, will be different for each manufacturer. The fact that we do not know what these demand functions are, nor know enough to forecast what they will be, is not relevant to the economic principles under consideration but is, of course, highly relevant to the problems that face the manufacturers in establishing their own prices.

In principle and without sacrifice of profits, prices should be set by the manufacturer whose own demand function is the same as, or closest to, the industry function. If, for example, prices for small cars were set higher (or lower) than those implied by the industry demand function, the manufacturer would under (or over) comply with the standard. A manufacturer whose product line was skewed, say on the high (or large car) side and who thus must effect a greater shift in sales mix would be faced with the prospect of either reduced profits, or curtailing production of its larger cars, or of being in noncompliance. While the lowest cost producer has an initial or "going-in" advantage, this company may not be in a position to effectively set prices if its demand function is



significantly different from the industry-wide demand function.

Consider now the situation facing the industry as it enters a given regulated model year. Each company, on the basis of its prior product decisions and its current best guesses of what is required, will set prices at levels which the company expects will result in the sale of a compliant mix of vehicles. It will also have set in motion such advertising and merchandizing programs and production schedules as it believes appropriate to the above goal. These initial prices may (or may not) be extraordinary as previously defined and will probably reflect to some degree pricing signals or the announcements of competitive manufacturers. As the model year progresses, each manufacturer will monitor closely its sales and new car inventories. If all the right decisions have been made, then sales will be compliant and inventories by car line and model will be in balance. If, as is highly likely, things start to get out of balance, then the manufacturers must attempt to assess and implement appropriate corrective actions. If the goal is compliance, with or without accepting reduced profits, then the manufacturer's choice is limited to some combination of the following:

- a) Price changes,
- b) Stepped-up or modified advertising programs,
- c) Special sales promotion or incentive programs--  
tantamount to price changes,
- d) Production scheduling changes.

The pricing issue is actually more complicated than that suggested above, since the choices available to the manufacturer include, in addition to the setting of base vehicle prices, the pricing of options and decisions about what items are included in the base vehicle and what items are offered and priced as options. Making sense out of new car prices involves seeing through the masking effect of changes in the specification and pricing of the base vehicle and the pricing of options. Of particular importance will be the manufacturer's pricing of its various engine/power-train options. Tending to obscure the picture is the circumstance that relatively little is known about the price elasticities of different

engine-power-train-performance-fuel economy combinations. The consumer, incidentally, is also faced with a bewildering set of information and claims which tend to impede rational choice--including the area of fuel economy.<sup>7</sup> It is likely that the most popular optional items will carry relatively higher price increases to permit lower base sticker prices on smaller cars. The base vehicle standard engine will tend to be the smallest offered, or that which provides the best advertisable EPA mpg rating, with larger engines carrying substantial premiums.

As the manufacturers are faced with a corporate compliance requirement, it is clear that they must develop appropriate allocation schemes to spread the burden--both among separate car divisions and among their retail dealer organizations. In the event the manufacturer faces a need to limit production of certain makes and models, some form of quota or allocation system will be needed. Ideally, the manufacturer would like to have free-market demand (given his initial pricing decisions) result in a compliant mix with each dealer able to satisfy his local demands. Given that there are regional differences in demand, as well as seasonal differences, the manufacturers will need to set targets (and possibly regional or individual dealer quotas) and tolerance limits for signalling the need for corrective actions.

The question of these and other strategies, including that of noncompliance, is discussed further in Task 4. The factors that will be considered by the manufacturers concerning pricing and other nontechnological options will involve assessments of the following:

- 1) Effects on profits and stockholder interests,
- 2) Effect on share of market and total sales,
- 3) The probable efficacy of advertising and public relations programs on shifting demand in desired direction, as well as effect on corporate image.
- 4) Effects on used car prices, scrappage and industry volume,
- 5) Effect on competitive relationships.

It is reasonable to expect that such analyses will be plagued by considerable uncertainty--both in terms of the future economic and regulatory environment and in terms of how much of each action will have what market effect--such that there is likely to be a period of experimentation (and market confusion) as the manufacturers each attempt to "tune" its system and determine what works.

Task 3 considers the problems and uncertainties relating to the environment within which fuel economy planning must take place.

## REFERENCES FOR SECTION 2

1. U.S. DOT/NHTSA, Data and Analysis for 1981-1984 Passenger Automobile Fuel Economy Standards-Summary Report, February 28, 1977, p. A-33.
2. Ibid., p. E-2, E-3.
3. Ibid., p. E-2.
4. For a discussion of the automobile planning cycle and lead times see Automotive Marketing Methods and Practice by Braden, Marshak & Whorf (TSC/613-0060) or the JPL study: Should We Have a New Engine?
5. The relevance of exogenous factors is discussed in Task 3.
6. For a discussion of "normal" automotive pricing see Chapter 5 and of issues relating to pricing under average fuel economy regulation see also Chapter 6 of Automotive Marketing Methods and Practice, Draft Final Report, June, 1977.
7. Patrick O'Donnell, "False Economy? New-Car Owners' Ire as Mileage Falls Below EPA Estimates," Wall Street Journal, August 31, 1977.



### 3. EXOGENOUS FACTORS THAT BEAR ON IMPLEMENTATION OF THE STANDARDS

As noted in Task 1, questions of feasibility and compliance for average fuel economy standards are inextricably related to factors bearing on consumer choice and market behavior. For purposes of the present discussion, "exogenous factors" represent all factors influencing consumer behavior concerning the use, ownership and purchase of automobiles that are not within the direct spheres of control of either NHTSA (charged with responsibility for implementing the standards) or of the automobile manufacturers (charged with responsibility for compliance).

It must be recognized that consumers respond to a wide variety of "signals" in making their purchase decisions consisting of both objective factors and their beliefs and perceptions concerning present needs and conditions and of their beliefs, perceptions and anticipations of future conditions. In addition to the obvious importance of income and the ability to buy (say, a new or used car, or other means of transportation), there are a host of other factors, some very subtle and illusive--but nevertheless real in terms of shaping behavior--that enter the consumers' equations for reckoning what they do with their money. In this regard, it is apparent that actions and potential actions of various units of government, other than DOT and NHTSA, can profoundly affect consumer choice regarding automobiles and hence the implementation of average fuel economy standards. Of particular significance are the President's current proposals for energy conservation, the question of the Congress' disposition of these proposals, and the effect on consumer behavior of any resulting legislation that affects the costs of ownership and operation of both new and used cars. Let it be noted in passing, and discussed further in Tasks 2 and 4, that each manufacturer must seek to understand, adapt to and reconcile the interplay of forces in three changing arenas:

- 1) Evolving government policy and regulatory controls as these define a set of constraints to be met.
- 2) Changing competitive conditions as influenced by the product and marketing decisions of other manufacturers.

- 3) Consumer attitudes, preferences and choices as manifested in the marketplace, which ultimately prescribes the conditions for success or failure.

Reviewed below are what are believed to be the principal exogenous factors and the probable directions of their effects on implementation of average fuel economy standards for passenger automobiles. While the major concern is with consumers as individuals, attention must also be given to the effect of these exogenous factors on fleet purchase decisions as representing a relatively small but nevertheless important segment of the market. Any exogenous factor that affects consumer purchase behavior must also affect, either directly or indirectly, manufacturer decision-making such that there are always chains of interactive effects to be given consideration. Similarly, there will also be exogenous factors that affect the automobile manufacturer directly, e.g., changes in factor prices, that will in turn affect consumer choice.

For convenience, exogenous factors are considered under four headings:

- 1) National Economic Climate
- 2) Energy Policy and Conservation
- 3) Other Factors Bearing on Costs of Ownership and Operation
- 4) Other Factors Bearing on Transportation and Travel Demand

The national economic climate and its general well-being as represented by real growth in GNP, Disposal Personal Income, employment and the customary economic measures, particularly as these are reflected in consumer confidence and expectations, determine in large measure the fortunes of the automobile industry in the aggregate. Cyclic downturns in the economy and the attendant reductions in sales adversely affect the manufacturers' profitability and ability to finance new product programs intended to achieve fuel economy and other corporate goals. Essentially all of the new car sales forecasting models incorporate one or more macroeconomic factor(s) as independent variables, but none of the

extant models has had much success in capturing the interactions between new and used car markets as these bear upon both scrappage rates and the segmentation of the new car market by size-class. As pointed out in the study on "Automotive Marketing Methods and Practice,"<sup>1</sup> at any given time the owners and users of automobiles have a wide range of choices in addition to the purchase of a particular make, model and class of new car, and the perceptions, beliefs, and expectations of consumers concerning a host of matters (as well as their financial resources) influence their decisions of when or whether to buy a new car, a used car, or one of a variety of effective substitutes for a "passenger automobile," e.g., pick-up truck, van or mini-bus, panel truck, sport van, various types of 4-wheel drive "off-the-road" vehicles.

Of singular importance to the questions of both manufacturer and market response are the effects of whatever actions Congress takes with respect to the President's Energy Policy and the level of public concern and opinion about the need for energy conservation. While there is considerable doubt about whether Congress will enact the Administration's proposed excise tax/rebate program or the gasoline tax (with speculation running high that it will reject the gasoline tax and the rebates--the latter because of strong opposition to subsidizing imports), the possibility of some kind of program, more or less like that proposed, illustrates the complications and uncertainty that such exogenous factors present for determining what are the maximum feasible standards. It is clear that one of the options available to the auto manufacturers involves pricing actions to "force" a compliant mix--representing an internal cross-subsidy of small cars by large cars. The tax/rebate scheme represents the government's preemption of a cross-subsidy, but there is no indication in the legislative proposal or support document of the basis upon which the particular taxes and rebates were established, nor is it possible to know at this time whether the amount of the cross-subsidy is just enough, or too much, or too little to move the market to choose a compliant mix. Since any schedule of taxes and rebates established at this time must be



arbitrary, the federal government would, in effect, be saying to the industry that it endorses the principle of a cross-subsidy but will leave to the individual manufacturers the task of further adjusting price differentials to fine-tune the subsidy so as to achieve compliance. But in this case, the standards themselves, i.e., any schedule of average fuel economy requirements, must also be regarded as arbitrary, since for any set of standards there is, theoretically, a corresponding set of cross-subsidies (taxes and rebates plus pricing actions) that would force the market into compliance. The question of feasibility would then depend only on the rate at which the manufacturers could convert their manufacturing facilities to the production of small cars and the amount of industry unemployment and lost sales that the government finds tolerable.

It must be understood that the new car market is not something completely separate and unaffected by markets for used cars and other motor vehicles. Increasing the prices of larger, fuel economical cars will inflate the value of the existing stock of large cars and, hence, reduce their scrappage rate. A substantial increase in the price of large cars will also have the effect of forcing many would-be buyers of large cars to purchase NPA's, i.e., light trucks, vans, etc. The reduction of large car scrappage rates, to the extent not off-set by increased scrappage of small cars, will reduce new car sales and keep the fleet average mpg relatively higher than otherwise. Reducing the prices of small cars to shift demand will also have the effect of devaluing the existing stock of small cars and thereby increase their scrappage rate. What cannot be known with any precision at this time, due in part to the uncertainty of other exogenous variables and in part to the inadequacy of our understanding of the market's dynamics, is whether the effects of any given set of price cross-subsidies on sales and differential scrappage rates will be sufficiently compensating to be neutral in the aggregate or to reduce (or possibly to increase) industry volumes. In any event, the adjustments are likely to be "jerky" and produce large year-to-year



variations, since the consumers' anticipations and "readings" of the changing price signals (and changing car attributes) will be confused. The system, therefore, is likely to exhibit the characteristic of "hunting" or in servomechanism terms, of an unstable system with positive feedback. It is appropriate to note, for example, that the taxes and rebates (or equivalent manufacturer price changes) can have a psychological effect opposite to that intended. A rebate or price reduction on a small car can reduce the perceived value of the car and lead consumers to wonder: What's wrong with the car? They can't even give them away! Similarly, but probably to a lesser degree, excise taxes and price increases can also communicate increased value and increased desirability to the large car. Such reactions also depend in large measure on the consumers' initial perceptions and images of particular makes and models and are not likely to be uniform across different makes and models. Thus a small car that is already perceived as a quality product would have its sales increased by a rebate--as a "terrific bargain;" whereas, a small car that is initially perceived as "cheap" or of poor quality is likely to have that image reinforced by a rebate or price cut as a "dog" to be avoided or to be not a "smart" purchase.

With regard to the matter of price cross-subsidies, there are important potential competitive effects to be noted depending on whether the subsidies are coupled with a schedule of excise taxes (with or without rebates). We consider the following three cases:

- 1) No excise tax or rebate. If one or more auto manufacturers, say GM and Ford, determine that they must adjust prices across car lines to achieve a compliant mix, then all manufacturers must attempt to set competitive prices. In this case, American Motors would probably be unable to compete, and the import car manufacturers would be adversely affected but possibly to a lesser extent than AMC to the degree that their sales are less price elastic than those of domestic small cars. Chrysler would probably be more severely strained than GM or Ford. These pricing and

competitive issues, however, are extremely complex as each manufacturer faces a different set of imperatives as a function of its existing product lines, market shares, customer loyalties, pricing flexibility and financial resources. It is not necessarily the case that the lowest cost producer will set the prices, but its initial advantage is substantial.

- 2) Excise taxes and rebates. In this case, the rebates that American Motors could presumably "earn" for its customers would tend to offset the competitive threat represented by its inability to internally cross-subsidize, but this effect depends on the degree to which the proposed schedule of taxes and rebates does not lead to additional cross-subsidies by the full-line companies. Critical to the rebate question, however, is the degree to which Congress or the White House can find a satisfactory way to off-set the windfall and competitive advantage bestowed on the importers of fuel economical small cars.
- 3) Excise taxes without rebates. This scenario, while technically neutral for American Motors, would have the side effect of inflating the value of the existing stock of large cars, thereby reducing scrappage for large cars, and consequently depressing total industry volumes. If total volume is down significantly, the smaller companies would be hurt disproportionately.

The proposed gasoline taxes, if enacted, will produce a combination of effects which, of course, would differ depending on whether the excise taxes with or without rebates were also imposed. Since the gasoline tax appears to be the least likely of the President's automotive proposals to be enacted, the relevant separate effects on car usage and sales of an increasing schedule of federal gasoline taxes are noted as follows:

- a) The increasing costs of operation would affect all users and purchases of automobiles (PA's and NPA's, new and used) and each would make his (or her) own trade-off between reduced usage and the purchase of more fuel economical vehicles in relation to his perceived needs and means.
- b) The reduction in fleetwide usage would tend to reduce scrappage rates and thus depress new car sales.
- c) The purchasers of both new and used cars would move in the direction of a more fuel efficient vehicle mix with a resulting relative increase in the scrappage rate for large cars and reduced scrappage for small cars, but without the sharp dislocations represented by a tax/rebate scheme imposed only on new cars.

Next, other factors bearing on costs of ownership and operation are considered. Anything that affects, either directly or indirectly, the costs of car ownership and operation can be expected to have some effect on purchase and use decisions, but it is appropriate to note that there are also a number of factors which tend to mask or reduce the perception of such costs (or benefits). For example, the widespread use of gasoline credit cards probably ameliorates to some degree the effect of gasoline price increases; whereas queueing at the gasoline pumps during the oil embargo prompted immediate response and public outcries. Similarly, the effects of new car price increases have been mitigated to a degree by the lengthening of loan periods, such that 4-year auto loans are not uncommon today.<sup>2</sup> Lengthening of the loan period also has the effect of increasing the trade-in cycle, and it may also have some effect on holding up prices for late-model used cars. An extremely important characteristic of general consumer behavior, and there are exceptions, is the relatively higher weight placed first on cost and carrying charges over operating and maintenance costs. Future benefits from reduced fuel consumption appear to be either highly discounted or valued lower than other attributes of the car. But generalizations in this area are precarious as there is an extremely wide variation among different classes of consumers.



It is not clear, even, to what extent fleet purchasers consider a net present value of future fuel savings in relation to initial cost or other vehicle characteristics.

Two industries that can change the ownership cost picture with significant effect are the insurance and finance industries. The demise of the "muscle car" in the '60's was in large part a result of the insurance industry's setting of very high premiums on such cars, particularly for drivers under 25 years of age who represented the primary market. Recently, there have been signs of a move to set differential rates (or discounts) on specific models as a function of "an individual model's damageability, repairability and attractiveness to thieves."<sup>3</sup> The effect of the stretching of car loan periods has already been noted. A more recent move, and one that could spread, is the offering of differential interest rates based on fuel economy. New York's Chemical Bank recently "began offering rebates on loans for the purchase of automobiles with high gasoline mileage ratings."<sup>4</sup> How extensive these and possibly other initiatives might become and the magnitude of their potential effects on shifting new car demand is not known; however, even very small shifts in demand can have a significant impact on the ease or difficulty of each manufacturer's selling a compliant mix of vehicles. For example, higher insurance rates on certain small cars because of increased accident liability and repair costs could, in addition to the direct ownership costs involved, heighten the perception (or predisposition on the part of many consumers--rightly or wrongly) that small cars are inherently less safe and thereby dampen demand in even greater proportion than might be expected from the direct insurance cost differential.

It is also the case that other factors bearing on transportation and travel demand can significantly affect consumer behavior, attitudes and preferences concerning types, characteristics and use of automobiles and hence either ameliorate or exacerbate the problem of compliance in complex ways. Noted below are some of these factors:



- a) Increased demand for RV's (recreation vehicles) and NPA's associated with increased leisure and disposable personal income and/or higher prices or unavailability of large cars with desired characteristics.
- b) Improvements in or incentives for increased use of public and quasi-public transportation (e.g., car pools and van pools).
- c) Imposition and enforcement of strict transportation control plans for achievement of ambient air quality standards.
- d) Costs (and incentives or disincentives) for intercity transportation by air, particularly for a family traveling together.
- e) Changes in single vs. multiple car ownership rates.
- f) Changes in characteristics of the housing stock and distribution of land use.
- g) Changes in the age distribution and other demographic characteristics of the population.
- h) Changes in social value systems, awarenesses and other factors bearing on life style, social well-being, urban conditions, crime, personal safety and security, social conflicts, etc., etc.

The most general observation appropriate to this entire section is the underscoring of the high degree of uncertainty and the high degree of complexity inherent in attempting to forecast consumer responses--for NHTSA's determining maximum feasible average fuel economy standards and for the manufacturers' setting detailed product and marketing plans and programs to achieve compliance. One could as easily be right for all the wrong reasons as be wrong for all the right reasons. An examination of automobile manufacturer decision making, strategy and concerns regarding compliance forms the subject of Task 4.

### REFERENCES FOR SECTION 3

1. Braden, Marshak and Whorf, "Automotive Marketing Methods and Practice," Interim Report on Contract No. TSC/613-0060, May 1977.
2. Donald Moffit, "Why Four-Year Car Loans Are Gaining Favor...", Wall Street Journal, June 6, 1977, p. 32.
3. Wall Street Journal, "Allstate Is Changing Car Insurance Rates for Several Models," November 11, 1976.
4. Edward Foldessy, "Firms' Fuel Sources Seen Growing Factor for Bank Borrowing," Wall Street Journal, May 19, 1977.

## 4. MANUFACTURER STRATEGIES

### 4.1 GENERAL

This section discusses possible and likely strategies of the automobile manufacturers in response to the average fuel economy standards for passenger automobiles. It must be stressed that this entire section is speculative, that the views and opinions expressed are those of the author, that they do not necessarily reflect the opinions of the Department of Transportation, nor do they necessarily reflect the intentions, position, or policies of any of the automobile manufacturers. The effort has been to develop a picture as reasonably as possible based on the preceeding task discussions and on observations of the past behavior and decision-making processes of this industry.

### 4.2 THE ISSUE OF NONCOMPLIANCE

It is appropriate to consider first the question of a possible strategy of noncompliance. It is fair to assume that any manufacturer, with reference to any federal standard or regulation, will seek to comply as long as the perceived costs of compliance are less than the perceived costs of noncompliance. While it is generally the case that the costs of compliance are measurable in monetary terms--notwithstanding the fact that in many cases there may be associated marketing or other risks and, hence, costs that are not readily quantifiable--it is also generally the case that the costs of noncompliance cannot be reckoned solely in monetary terms, i.e., in terms of the dollar fines and penalties that may be imposed. The probable response of the automobile manufacturers, for reasons to be discussed further, is not expected to represent a straightforward profit maximizing strategy in which the civil penalties, suitably adjusted, are treated as just another cost of production. Allen Jacobs of MIT's Energy Laboratory,<sup>1</sup> however, has undertaken a useful and interesting economic analysis of manufacturer strategies of noncompliance based on a premise of a profit-maximizing response treating the penalties as an extra cost of production.

Both the Congress in debating the fuel economy legislation and FEA's C. Difiglion<sup>2</sup> considered that mandated fuel economy standards and excise taxes/rebates are functionally equivalent in that the manufacturers would treat the civil penalties as excise taxes and that the consumer would be indifferent to the source of the resulting change in prices, i.e., whether a tax or a price increase representing a pass-through of the civil penalty. Such analyses, while perhaps useful, do not adequately reflect the decisionmaking and imperatives of the auto manufacturers. There are situations, of course, in which a manufacturer will "opt" for noncompliance, e.g. situations characterized by one or a combination of the following:

- 1) A finding or conviction that the standards are technologically infeasible--or more strongly, are technologically unachievable.
- 2) The "threatened" sanctions for noncompliance are politically unenforceable, or, possibly, a perception that the government lacks the will to enforce or invoke statutory penalties.
- 3) There is a strong conviction that there would result (or could be generated) sufficient political pressure to cause Congress to amend or nullify the standards in time to grant relief.

None of these situations are believed to apply, at this time, in the case of the fuel economy standards. There are, moreover, two compelling reasons for concluding that the manufacturers will proceed on the basis of a policy of compliance. First, there must be concern that a policy of deliberate noncompliance (or the treatment of civil penalties as costs) will lead to a response from the Congress in the form of an enactment of stiffer penalties and/or the imposition of criminal liability on top management for deliberate noncompliance. Second, it must be recognized that improved fuel economy represents a direct concern of most consumers, such that the consumer's perception that a company is deliberately non-complying would pose for the manufacturers an enormous cost in terms of adverse image and public attitudes, as well as the prospect



of stockholder or other suits against the company. A number of corollary observations may be made:

- a) The manufacturers may be expected to invoke measures and incur costs, if necessary, to achieve compliance, over and above those that could be expected on the basis of a marginal cost and profit analysis in which the civil penalties are treated as an adjusted (before tax) cost.
- b) The circumstance of noncompliance for one or another manufacturer would probably represent its inability, even with extraordinary pricing within its capability, to force its customers to purchase a compliant mix of vehicles, excepting the remote possibility noted in the next item.
- c) A possible, but now considered very unlikely, dramatic change in the political climate concerning either the need or means for achieving energy conservation, or a perception by the manufacturers of an opportunity to thwart the implementation of the present standards could lead to a covert strategy of noncompliance or one that seeks to precipitate an amendment of the legislation. Normal lobbying for reduction in regulatory constraints, however, can be expected to continue unabated.
- d) The manufacturers, furthermore--and as a minimum--must be mindful of pursuing those activities and programs that would be appropriate to a demonstration of "good faith" in seeking compliance and for the building of a defensible case in the event of noncompliance.

A final observation on the question of noncompliance is perhaps in order. Comments are not infrequently made that the auto industry is an "harassed" industry, with the further suggestion that it will simply "lay back" and let the government assume responsibility for whatever disasters it (the government) creates. While there are some signs of a feeling of harassment, it must also be observed that this industry has a number of strong and tough-minded men in top-management, such that probably the least likely scenario is one in which these men either simply abdicate or attempt to delib-

erately exacerbate the dislocations that could follow from fuel economy, or any other, federal regulations. This notwithstanding the belief that the government does (or should) assume a burden of responsibility for the consequences of mandating average fuel economy standards.

#### 4.3 OVERALL STRATEGY

The following numbered paragraphs characterize what is believed will be the general strategy of the automobile manufacturers in their efforts to assure compliance with the mandated average fuel economy standards. Subsequent sections consider each of the domestic manufacturers separately.

- 1) The touchstone of all fuel economy related forward product and facilities planning programs will be to provide as much flexibility as possible to the corporation for selling each year a compliant mix of vehicles with minimum dislocation of markets, pricing and profits.
- 2) Systems for the continuous monitoring of the corporations's average fuel economy performance will be installed. Serious efforts can also be expected to develop and apply some form of optimal compliance control strategy. Such control systems will attempt to incorporate all possible degrees of freedom and cost elements with some form of dual objective function, i.e., of the compliance criterion and a profit criterion. How effectively such control or decision systems can be made to work is certainly open to question, but considerable advantage will accrue to the one who can learn how to do it best.
- 3) In support of Item 2, there will almost certainly be considerably intensified efforts to develop and refine improved techniques for forecasting changes in market segmentation, including regional and seasonal or other short term variations in mix, in relation to the widest possible range of variables (both externally

and internally controlled) that can differentially affect consumer demand. Special attention must be given to an attempt to better understand the effects of price changes, including price cross-elasticities, on the mix of vehicles purchased.

- 4) Primary and corporate-wide responsibility for forward product planning and the assessment of technological options will be placed in a corporate-level product planning function which, however, may be in either a staff or line organization. Any and all product changes must be assessed in terms of their fuel economy contribution, their potential effect on marketability and consumer perceptions, their costs, lead-times for implementation, and any potentially adverse affects upon other regulated areas or other product choices. There is, of course, an obvious preference ordering of choices which begins with pure efficiency gains or fuel economy improvements at low cost that have no adverse marketing implications, on down to those product changes that imply increasingly larger reductions in perceived value by the consumer or entail increasingly larger marketing risk. There have been extensive discussions in hearings and material submitted to the relevant NHTSA dockets concerning the range of technological choices and their potential risks. While there appears to be little in the way of significant differences between the manufacturer and DOT assessments of potential fuel economy gains from the various technological options, there remains considerable doubt and difference of opinion on the extent to which such product changes are neutral from a marketing point of view. The weighting of such risks or the extent to which each manufacturer will pursue a risk avoidance strategy will depend upon its own assessment of its market strengths and customer loyalty and upon how far it

must move to achieve compliance. Thus General Motors, which enjoys very strong customer loyalties, both corporate and brand, will tend to weigh the marketing risk of its product changes (including, say, dieselization) less heavily than American Motors or Chrysler who have considerably weaker loyalties and market positions.

- 5) With the need to "sell" more small cars, the industry will seek to build more luxury and "appeal," over and above fuel economy, into their small cars, such that "moving down" can be perceived and promoted as "moving up." The ability to visually differentiate through styling changes the separate makes of small cars will be relatively more constrained than in the past, with consequent increased emphasis on ride quality, handling and interior appointments.
- 6) Each of the companies will surely seek to identify and exploit opportunities for increased sales of non-passenger automobiles (NPA's) and RV's.
- 7) Primary responsibility for assurance of current model year compliance will be nominally vested in a corporate level (staff or line) marketing function, but the responsibility will effectively be the conjoint responsibility of both marketing and finance staffs (reflecting the dual objective function implied in seeking an optimal control). Critical elements will consist of forecasting, monitoring, pricing, and production scheduling (corporate-wide).
- 8) Part of the flexibility strategy will involve facilities planning, with a possible move away from facilities dedicated to single car-line assembly and single-purpose tooling or production machinery, increased reliance or encouragement of supplier industries to develop innovations in materials technology, and increased emphasis on interchangeability of parts and subassemblies.



- 9) The "Big Three" can be expected to place increased emphasis on technology developments by their foreign subsidiaries that will be relevant for manufacture in the U.S. or for incorporation in domestically produced vehicles. While such items as front-wheel drives (with transverse engines) and other power-train developments are clearly at issue, there may also be complete vehicle programs (such as Ford's Fiesta) which could be phased into domestic production. U.S. manufacturers will also develop closer technological and commercial ties with foreign manufacturers for the purchase and/or manufacture under license of major power-train systems or subsystems.
- 10) A major problem and perhaps the major uncertainty concerning manufacturer strategies is the question of how they will trade off between technological and nontechnological options (as discussed in Task 2). It is believed that the manufacturers themselves have not yet resolved the issue and that they have not yet developed or have not sufficient confidence in the analytic and evaluative tools required for "rational" trade-off analyses. With regard to the '78, '79, and '80 model years, effectively all of the major product and facilities decisions have already been made, such that the "trade-off" question is moot, and the question of compliance rests with the marketing/finance "team." With regard to succeeding model years, it is believed that the manufacturers will in general attempt to minimize risks, but more particularly will pursue the following:
- a) Concentrate major attention, as suggested in paragraph 2 above, on the development of analytical techniques for the evaluation of the profit and compliance implications of alternative options--both technological and nontechnological.

- b) Minimize marketing risk to the extent possible and consider as last resorts those options which conflict with the customers' value preferences-- unless or until the manufacturers believe that all of them are in the "same boat."
- c) Bank as much technology as possible, with major emphasis on materials and weight reduction innovations.
- d) Keep all options open as long as possible and "play" marketing and pricing decisions from a "closed hand" as long as possible.
- e) Mindful of the potential need to demonstrate "good faith," the manufacturers will favor the more "visible" technology options, i.e., those which would contribute to the perception of a serious and wholehearted commitment to compliance. The downsizing and materials substitution programs and cases in point nevertheless carry some, but probably not major, marketing risk. For the same reason, a major part of advertising will carry strong conservation and fuel economy messages and stress how much the company has done to conserve energy.
- f) Each, of course, will keep a close eye on the others to "read" as much as possible of their plans and intentions, including relative emphasis on "product" versus "marketing" solutions to compliance.

While the above general elements of strategy may appear obvious, it should be noted that there is considerable difference of opinion and uncertainty within the industry about how far, or to what degree, any option should be or can be carried and about what the net effects of contemplated product changes will actually turn out to be. Take the downsizing programs as an example. While the results to date of GM's downsizing its full-size cars have been

very encouraging, it must be remembered that GM has very strong brand and corporate loyalty and that during the 1977 model year there had been considerable pent-up demand for the larger size cars. What is not known, as the downsizing program moves progressively to smaller size classes, is the extent to which buyers of present car classes will move up to the new downsized cars, e.g., subcompact buyers to compact, compacts to intermediate, intermediates to standard, and even possibly standards to NPA's. It is entirely possible that there will be a tendency for a sharper peaking of demand in and around the new intermediate class cars. The extent to which this may happen depends to a critical degree on the unknown factor of the price differentials that the newly-sized cars will carry.

An additional factor of major importance is the circumstance that the industry is entering a period of rapid and far-reaching change in product features and characteristics, probably the greatest in its history. The industry normally thrives on product change, even trivial cosmetic changes, such that there will undoubtedly be a period of considerable "excitement" and consumer interest in the new product introductions. But it will also be a period of considerable uncertainty and confusion--on both the part of the producers and the consumers. Critical in this context will be the consumers' responses to their applications of either better or worse things to come. While no one can be exactly sure of what will happen, it is reasonable to expect a relatively prolonged period of sharp cyclical change and experimentation during which the manufacturers attempt to fine-tune their systems and initiate corrective actions in their efforts to complete each year with a compliant mix of sales.

#### 4.4 THE DOMESTIC AUTOMOBILE MANUFACTURERS

A substantial amount of information concerning the plans, programs and assessments by each of the domestic manufacturers has been submitted to NHTSA in response to the ANPRM, NPRM, Public Hearings, and the Special Order of April 1, 1977. For much of this information, the manufacturers have requested, and been

accorded, confidential treatment, and the present author has not seen, or had access to, any of the confidential submissions. Accordingly, it is highly likely that some of the judgements and inferences presented below will be at odds with the expressed positions or intentions of the manufacturers. Further, since much of each company's comments were not in the public record, rather than present a detailed review of the public portions of these submissions, it appears more appropriate for the present purposes to attempt an independent assessment of the probable strategies of each company based on the principles and problems discussed above and in the prior tasks, the author's observations of the behavior of the industry, and recent coverage of the industry by the trade and business press.

#### 4.4.1 American Motors Corporation

American Motors, smallest of the Big Four, financially troubled and with very limited resources in relation to its larger competitors, will face extreme competitive pressures in its traditional markets--pressures, particularly if the larger companies find they must resort to internal cross-subsidies to sell a compliant mix, could threaten its survival in the passenger car business. AMC's primary strategic concern must be that of survival, notwithstanding the frequent displays of optimism in public statements by senior executives.<sup>3</sup> Typical is that of the Chairman, Roy Chapin, as quoted in Automotive News:<sup>4</sup>

"First we are positioned where we want to be." The company is firmly committed to the small-car segment, the major volume market of the future. It has no intention of reentering the full-sized car market. The company will stay in the highly competitive intermediate car market. "Secondly, we have an organization that has not lost its ability to be ingenious and competitive." The company will stick to its philosophy of difference. "Lastly, we are supported by a considerably effective diversification." Chapin pointed out that 50 percent of the corporation's sales are non-U.S. passenger cars.

Of course, an official show of confidence and optimism is de rigueur in the circumstances. Summarized below are what appear to be the major factors bearing on AMC's situation as the company enters the era of fuel economy regulation:



- a) An aging product line, and a longer major-product-change-cycle than its domestic competitors--forced by its more limited financial resources.
- b) A virtual inability to bring out any completely new cars until the 1980 MY--the Concord being introduced in '78 is a restyled and renamed Hornet.
- c) The need to rely heavily on outside supplies for significant technology developments, as evidenced recently by the purchase of its new 4-cylinder engine from VW.
- d) Relatively weaker customer loyalties than any of its domestic competitors and the major imports.
- e) A strained and declining dealer organization, which because of slow AMC passenger car sales is concentrating increased attention on used car, jeep and parts sales and dualing with other car makes.
- f) A financial plight marked by substantial losses on passenger car sales, the sale of a parts manufacturing plant in West Virginia to VW, to raise cash, increased costs for its line of credit<sup>5</sup> and its auditors, Touche, Ross & Co., issuing a qualified opinion in the Company's last annual report:<sup>6</sup>

As described in Note B (to the Financial Statements), the Company has outstanding short-term notes to various financial institutions on September 30, 1976, pursuant to credit agreements that are renegotiated and renewed each December. The continuity of the business of the Company depends upon the availability of adequate financing as well as an improvement in operating results.

It must be recognized that the Company's products for the next three model years, '78, '79 and '80, are effectively prescribed, or at least severely bounded, by decisions made and actions already taken during the last three or more years. The NHTSA Support Document<sup>7</sup> asserts that "American Motors is planning a new, lighter weight Matador for the 1980 MY and a new front-wheel drive, mini-

sized car for 1979." Other assumed changes include relatively modest weight reductions, engine downsizing and introduction of the new 4-cylinder engine in the Gremlin and forthcoming mini.

What, if anything, AMC can or will do in the post-80 passenger car market will probably hinge on a) its ability to lower its break-even sales volume point through cost reductions, b) its willingness or ability to support passenger car operations from profitable non-passenger car businesses, or c) its ability to find a suitable niche. It is believed that AMC has neither the intent nor the resources to compete across-the-board; however, a merger with, say, Volvo might make sense from AMC's point of view. It appears fair to assume that one strategy, or contingency, that AMC's management must consider seriously is its withdrawal from the passenger car business. Whether, or under what conditions, this might come to pass will probably be made evident before the 1981 model year. There will have been three years of fuel economy regulation, and the feasibility of competing with GM and Ford and the imports for a profitable share of the small car market will almost certainly be clear. A heavy excise tax on "gas guzzlers," a substantial gasoline tax, or a minimum fuel economy standard will ease AMC's burden; the absence of these, an economic downturn, or a "pricing war" by Ford and GM to sell "enough" small cars will hasten AMC's demise.

In the meantime, AMC's strategy will probably consist of the following:

- a) "Exude" confidence and optimism,
- b) Concentrate on promoting NPA (Jeep), military and transit vehicle sales,
- c) Concentrate on internal cost reduction and cost control programs to keep the passenger car break-even point as low as possible,
- d) Reduce the weight of its present vehicles as much as possible and promote installation of the L-4 VW engine,
- e) Negotiate, if feasible, for procurement of a small diesel as an optional power plant, presumably with VW.

#### 4.4.2 Chrysler Corporation

Chrysler appears to be substantially more vulnerable to cyclic variation<sup>8,9</sup> than its two larger competitors. As such, its ability to generate the capital desired for new product programs depends critically on maintaining market penetration and adequate sales levels. Chrysler appears to be relatively well-positioned with its current and forthcoming product line. The company is relatively strong in the intermediate-size class. It will be the first of the U.S. companies with domestically produced front-wheel drive small cars (the Omni and Horizon, based on the VW L-4 engine and transaxle), and it has dropped from its line the very large Gran Fury and Royal Monaco. The company is engaged in a program of resizing all its car lines, involving reductions in weight, size and engine displacement.

Recent reports<sup>10</sup> indicate that Chrysler may introduce a diesel version of its 225 CID L-6 in 1979 or 1980 and that it is also considering the purchase of a VW 4-cylinder diesel for use in its Omni and Horizon minis. Chrysler is also developing a 2.2-liter 4-cylinder engine of its own, and a CVCC-type stratified charge version is also under development for possible introduction in the 1980s.

The move in March of Harold Sperlich from Ford to Chrysler's top product planning position (V.P. Product Planning and Design) is likely to significantly affect the company's products in the 1980s.<sup>11</sup> Closer working ties with Mitsubishi on new product developments are suggested as a possibility, and Chrysler's overseas subsidiaries could play a larger role in domestic product-planning.

On the distribution side, Chrysler has announced a plan for setting dealer targets consisting of the ratios among different models required for meeting the fuel economy standards. This plan is reported to be generally well-received among its dealers.<sup>12</sup>

With Chrysler's need to maintain sales volumes, the critical question facing the company is its ability to sell enough small



cars in competition with GM and Ford who will be vying for the same market to balance their own lines. We don't know the answer. If industry volumes stay at relatively high levels, Chrysler should fare reasonably well; if there are two or more years of substantially depressed industry volumes, then Chrysler's passenger car business would be severely affected. It is appropriate to note that Chrysler is strong in the NPA market, particularly with its vans, such that we expect increased emphasis on promoting such sales.

#### 4.4.3 Ford Motor Company

Ford is entering the era of fuel economy regulation with its new mini, the Fiesta, imported from Europe and two new compacts, the Ford Fairmont and Mercury Zephyr, having already downsized the Thunderbird from full-size to intermediate and the LTD to the LTD-II (a revamped Torino) as an intermediate. Ford's announced strategy<sup>13</sup> involves:

"A program of downsizing which is as radical as possible but still provides an array of vehicles that satisfy basic consumer demand. To that end, we plan on a four-phrase approach with specific improvements to be made through (1) downsizing actions (package efficiencies), (2) major substitutions of light-weight materials, (3) powertrain efficiencies and (4) aerodynamic improvements."

In the company's oral testimony, Mr. Misch<sup>14</sup> asserted:

"At this point our plans are far from firm, but we have considered a number of marketing and engineering actions that offer the potential for meeting this goal [a 1985 fleet average of 27.5 mpg]. We are evaluating a spectrum of strategies ranging from heavy reliance on mix shift to moderate mix shifts with substantial dependence on new and unproven power-train technologies--looking for the lowest risks and costs for both ourselves and the consumer."

Among the power-train options under consideration by Ford, the following may be noted:

- a) Dual-displacement engines, with possible first introduction on Ford's '79 light trucks;<sup>15</sup> incorporate electronic controls and sensors to switch operation from 6 cylinders to three under light load conditions.



- b) The PROCO (programmed combustion) engine, a direct injection stratified charge engine which Ford characterizes<sup>16</sup> "roughly as a gasoline version of the diesel," has been the subject of substantial R&D work but is still regarded as "high-risk technology." Its production would involve substantial reworking of the company's manufacturing facilities and is not scheduled for near-term introduction. The PROCO still appears to represent Ford's "best bet" for mid-term application, i.e., during the next 10 to 20 year period.
- c) Ford has no current plans to introduce diesel engines in its domestic passenger cars, but the question is subject to periodic review. It is appropriate to note that Ford has recently negotiated with Fiat<sup>17</sup> for the importation of diesel engines in the 45 to 150 horsepower range for nonautomotive applications, and with Peugeot<sup>18</sup> for the purchase of diesel engines for passenger cars produced in Europe.
- d) The Stirling engine, the subject of continuing R&D, is a longer term hope than the PROCO and certainly doesn't figure in any near-term model plans.
- e) There has been some interest in an automatic shut-down, automatic restart engine (shut-down on deceleration and idle), but there appear to be serious problems with emissions or other development problems. There are no known plans for its early introduction.
- f) There are conflicting reports<sup>19</sup> on Ford's plans to introduce 1.6 and 2.3 liter CVCC engines in a line of small cars by 1980. While development work is proceeding, Ford is probably keeping its options open--on this and other engine development programs.
- g) Ford can readily provide overdrive and mechanical transmissions, but there has been an expressed concern<sup>20</sup> about the negative effect of mechanical transmissions on emissions through the feedback of road

shocks to the engine.

On the marketing and distribution side, Ford has expressed concern about the possible need to bring about a mix shift through pricing, including options pricing, and/or production cutbacks, dealer allocations and other marketing programs. Bennett Bidwell, sales group vice president, recently quoted in Automotive News,<sup>21</sup> said:

"Sound advertising, sales training and judicious applications of price differentials will be our tools for downsizing the engine mix and shifting the small-car, big-car mix from 40/60 in 1977 to about 50/50 in 1978....We think that kind of mix is consistent with free demand."

He noted that if the company finds it can't support a free-demand mix, "we'll simply have to cut big cars from the production schedule even if our dealers already have retail orders in hand."

"If we do have to put further controls on production, ....the result will be the allocation of lower-fuel-economy cars on the basis of dealer average fuel economy."

It is clear that Ford intends to compete across-the-board and will probably hang on to its large cars as long as it feels it can. If the Fiesta sells well in the U.S., a domestic version or its assembly in the U.S. is highly likely.

#### 4.4.4 General Motors Corporation

General Motors is engaged in an ambitious program of downsizing all of its car lines and engine offerings, the specifics of which are reviewed in the NHTSA Support Document 3.<sup>22</sup> This program is well advanced, and GM stands in relatively the strongest position for meeting the fuel economy standards with an anticipated 1978 fleet average of 19 mpg.<sup>23</sup> GM also appears to be the most bullish about the new car market, projecting 1978 passenger car sales of 11.75 million units.<sup>24</sup>

While the overall downsizing program applies to all car divisions and separate car lines from different divisions will share basic bodies and other components, General Motors appears to have a unique opportunity to differentiate and spread both technological and marketing risks by selectively introducing innovations in the

products of one or another car division. Each of the five car divisions and the two truck operations, GMC and Chevrolet, can be assumed to have relatively distinct images, customer loyalties and market appeals such that GM has in effect up to seven different test beds for market testing of various technology options. There is some evidence to suggest that GM is proceeding in this fashion. The following may be noted:

- a) GM's first passenger car diesel, a 350 CID V-8, will be offered in the Oldsmobile 88 and 98 series passenger cars and GMC and Chevrolet light trucks.<sup>25</sup>
- b) New turbocharged 231 CID V-6 engines will be offered by Buick in the LeSabre and Century/Regal Series.<sup>26</sup>
- c) It has been reported that Buick will introduce a front-wheel drive Riviera with the turbocharged 231 V-6 in 1979, sharing a 114-inch wheelbase with the Oldsmobile Toronado and Cadillac Eldorado.<sup>27</sup>

It can be expected that successful innovations will spread to other car lines and divisions, particularly in view of the strong incentive to achieve a high degree of commonality among parts and subsystems. It is appropriate to note, however, that strong images once built can be highly resistant to change as GM is witnessing to its displeasure in the case of the Olds "Rocket" engines and the now notorious Chevrolet engine switches.<sup>28</sup> A possibly more potent counter-incentive to GM's adopting an aggressive risk-taking posture is the perception that the company may have more to lose than gain. We see little reason to expect any dramatic change from a predominantly risk-avoidance or risk-minimizing strategy. Such a posture is not inconsistent with a high level of advanced R&D and new technology development work aimed at providing the company with a wide range of technology options to respond to any likely contingency.

On the marketing and distribution side, while no official company position has been noted in the trade press, it must be assumed that GM has under consideration some form of standby dealer allocation scheme to assure Corporate compliance in the event free-



market demand goes awry. With the company's confident projection of a 1978 fleet average of 19 mpg, there is little reason for any advanced notice concerning dealer allocations. GM's announced prices for the 1978 model cars show that the company is moving to increase the price differentials between large and small cars. Quoting from Terry Brown's analysis in the Wall Street Journal:<sup>29</sup>

This year, some industry analysts speculate that GM executives are concerned about the acceptance of their restyled intermediates, which will be a more radical departure from their year-ago counterparts than were GM's big cars last year.

For that reason, analysts believe GM may want to re-establish a more traditional price spread between its large cars and its new intermediates. Accordingly, they think GM may put rather hefty increases on its large cars this year, but keep price boosts on the restyled mid-size models at a lower overall average increase.

The partial price list GM did announce indicates the automaker may, indeed, be following that pricing strategy. Many of the larger increases are concentrated on the company's full-size cars, which in general have been selling well all year. The base price of the Pontiac Bonneville Brougham coup, for example, increased \$680, or 11.5%, to \$6,577. The base price of the Buick Electra 225 Custom coupe rose \$493, or 7.1%, to \$7,143.

In line with this strategy, GM actually cut base prices on some of its top-of-the-line compact models, which in some cases will compete directly with GM's new intermediates and actually be bigger cars in terms of overall external dimensions.

On the Buick Skylark SR coupe, for example, the company reduced the 1978 price \$296, or 6.5% to \$4,242. On its Chevrolet Nova custom sedan, the new price was cut \$42, or 1%, to \$4,035.

On the issue of pricing, while GM is undoubtedly aware of the potential impacts of its pricing decisions on other smaller firms, there appears little reason to believe that the company's overriding concern will be anything other than its own corporate need (and legal imperative) to sell a compliant mix of vehicles.



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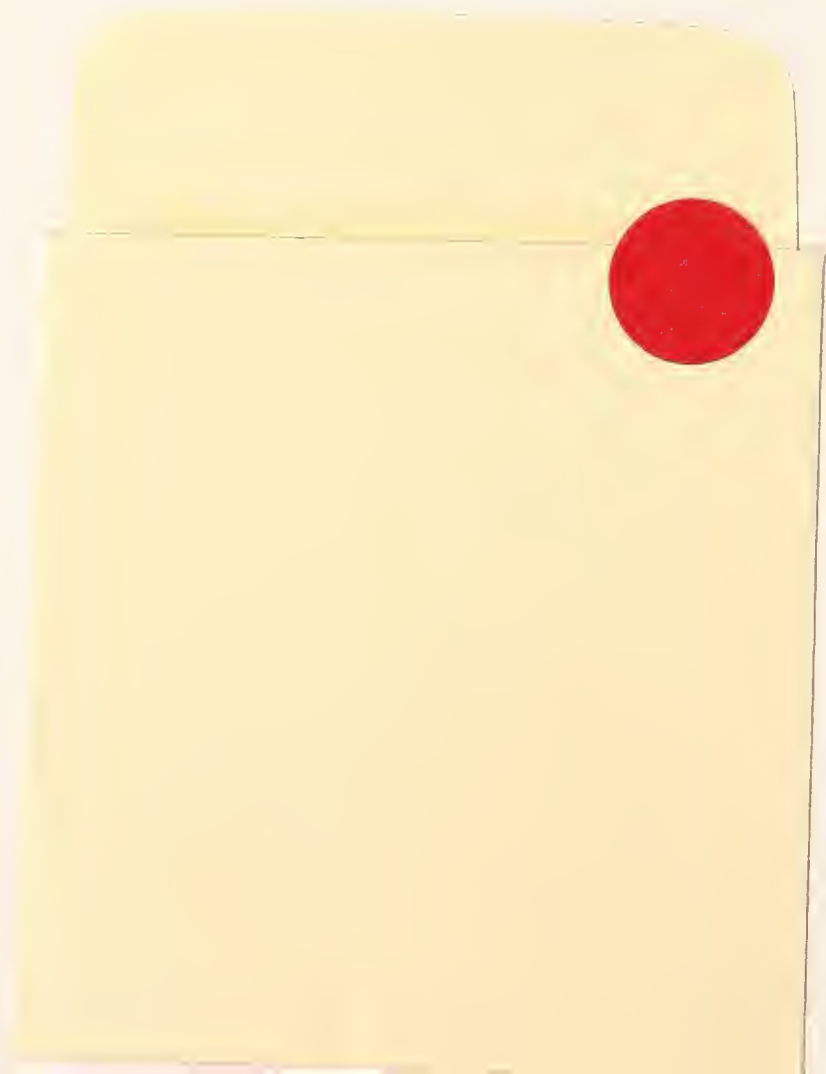
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APPENDIX  
REPORT OF INVENTIONS

A diligent review of work performed under the contract has revealed no innovations, discoveries, or invention; however, this contract has resulted in improved knowledge on the issues bearing on automobile manufacturer's decision-making in regard to meeting fuel economy standards, and the probable responses of these manufacturers.





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